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ABSTRACT

This paper introduces a new application called multimedia annotation, currently being developed in the European Union-funded project DIANE. A system for instant multimedia authoring, with special features for supporting the creation of multimedia documents in a distributed working environment such as distance education, is described. The system gives both teachers and learners the capabilities for multimedia authoring, which makes learning a collaborative effort with important feedback from learners improving the quality of the teaching material. Topics discussed include the annotation engine, system usage, and the use of DIANE in distance learning scenarios. Two figures illustrate the annotation engine and the DIANE document viewer. Contains 16 references. (Author/DLS)

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A Multimedia Authoring And Annotation System For Learning Environments

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Abstract: In this paper we introduce a new application called multimedia annotation, which is currently developed in the EU-funded ACTS project DIANE. We describe a system for instant multimedia authoring with special features for supporting the creation and annotation of multimedia documents in a distributed working environment e.g. distance education. It gives both teachers and learners the capabilities for multimedia authoring, which makes learning to a collaborative effort with the important feedback from the learners to improve the quality of the teaching material.

ED 428 668

1. Introduction

The decreasing cost of computers with multimedia capabilities and the increasing availability of high-speed networks like ISDN or ATM emerge new possibilities for distance learning and teaching concerning the use of multimedia [Abowd et al. 96, Muehlhaeser 95, Luther 94, Edwards et al. 92]. Several approaches how multimedia can be used to support teaching at universities and schools were proposed (virtual university, authoring on the fly, use of whiteboard applications as a replacement of chalkboards) [Ottman et al. 95, Bacher et al. 96, Bacher et al. 97, Will 96, Will 97], but they are often not general enough to be applied to other distributed working environments without problems or changes.

The possibilities of multimedia allows to adapt the content of a teaching course to the preferences of learners, but in a distributed learning scenario this flexibility is not taken into account due to the missing contact between teachers and learners: a teacher in a classroom scenario can vary the content or the structure of his course or lessons according to his experience with the learners and can fine-tune or adapt the course to the specific needs and interests of the students. In a teleteaching scenario this possibility of positive feedback is very limited, although it would enhance the quality of learning considerably.

Most teleteaching courses on the Web are HTML-based documents [Langenbach et al. 97, Kutschera 96]. The only possible feedback of the learners is email to the teachers or WWW-based forms to allow suggestions or questions. Both methods have the drawback that they are completely text-based and referring to the course or its content is difficult.

Teletraining and distance education typically require a lot more preparation time than traditional classroom teaching. Incorporating the feedback of students and the adaptation of the course are features, which would result in an enormous increase of time for course preparation.

The annotation system [Fischer 96, Benz et al. 97a, Benz et al. 97b, Benz et al. 97c] described in this paper is being developed in the project DIANE.[1]

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Actually, a system based on annotations offers a solution to the problem above: the course material can be annotated by the students with all the media available, each part of a document can be referred to or changed by adding questions, suggestions, thoughts or comments. This feedback of the learners results in annotated documents, which can be taken as the basis for a refined course. This interaction between teachers and learners is an essential point for improving the quality of the teletraining material. The learners are not left to study by themselves, but get tutors assistance and are able to collaborate with other participants of the course via DIANE.

The teacher plays more the role of a coach or moderator (as in moderated newsgroups) for providing the basis for a discussion, while the final course material with all the contributions from the students itself is developed during the lessons and is more or less a by-product of the learning process.

This approach has turned out to be very successful especially in collaborative working environments as it can be seen from the increasing number of newsgroups and mailing-lists, which support the annotation feature in a text-based form. The extension of authoring to a variety of media as offered by DIANE results in flexibility in the selection of the appropriate media and a shorter document creation time both for instructors and students.

2. The Annotation Engine

The engine shown in Fig. 1 can be seen as a series of players, each one capable to present a multimedia document. The synchronised output of the players is sent to the various devices in the system: audio, mouse display, windows system, etc. The annotation process, however, implies the creation of a new document Di+1 based on the presentation above plus additional live media (such as audio, application output, video, etc.). The new document is stored in the document database.

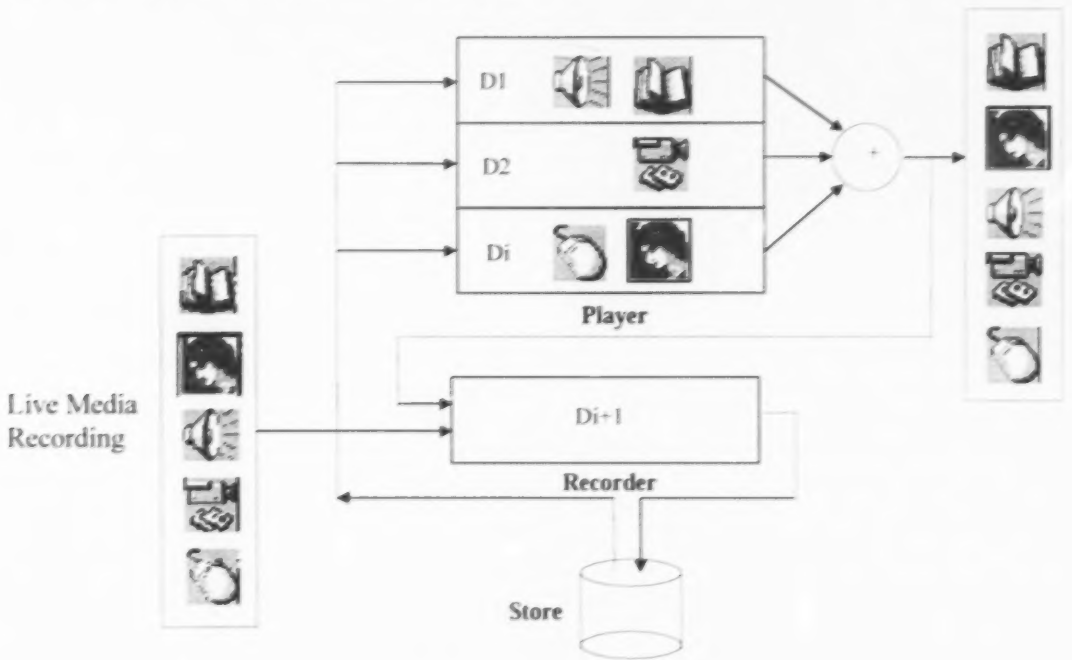

Figure 1: The annotation engine

The set of documents D1, D2, Di feeding the players in Fig. 1 are not selected arbitrarily; they represent a thread linked by special links, the annotation links. Assuming in this example that Di is an annotation of document D2, the semantics of the link Di->D2 is to combine the presentation schedules of both documents

according to time and spatial reference points (created while recording Di). Therefore, when the user selects Di for presentation, the engine loads Di, D2 (and recursively D1 since D2 is an annotation of D1), resolves the references and creates one, combined presentation schedule.

3. System Usage

The annotation system was designed to be general and support almost any distributed working environment. Other multimedia authoring systems have the drawbacks of being either too application specific, too complex to use, or have no support for distributed environments.

These limitations are not present in DIANE:

- application output recording (screen grabbing) in a continuous or frame-by-frame mode creates a media which is integrated into documents in form of an animation or slide show. Therefore, any external, available tools can be used for authoring.
- the user interface to DIANE follows the VCR paradigm, being easy and intuitive to use.
- the client-server architecture with a central server for document storage and management and clients for authoring and annotation is appropriate for distance learning.

Annotations in DIANE are comments, suggestions, thoughts, questions or markers realised with text, images, slide show, video, audio, mouse movements). Actually, DIANE can handle and retrieve multimedia streams from various sources like camera, microphone, applications screens or files without the help of third-party tools. This makes it particular easy for a user to integrate any media object into his documents.
A DIANE document with slide show media (collection of frames from the screen output of an application), audio, pointer, text and image can be seen in the following figure. The VCR-type buttons on the top of the window allow the replay, pausing and recording of annotations.

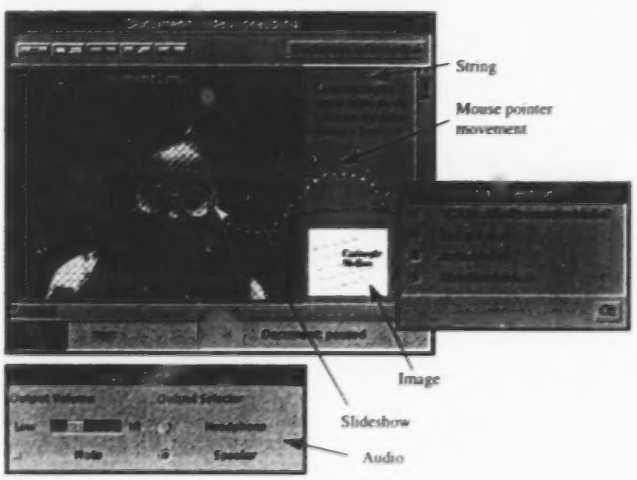

Figure 2: DIANE Document Viewer

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Annotating a document like the one in Fig. 2 is done by pressing the (red) annotate button. The presentation is paused and a new document with the original and new media is created. The added objects become visible when the replay time of the annotated document is equal or greater than the annotation time.

4. Use of DIANE in distance learning scenarios

DIANE is also well suited for various learning scenarios and can be customised to any working environment when necessary. In order to answer the needs of data security in corporate environments like companies, hospitals or research centres, authentication and encryption of the communication over the network has been combined with a role-based access control applied to each document. Thus, viewing of whole threads of annotations can be restricted to certain closed-user groups.

The first step in distance education is always the preparation of the course material. The system is content neutral and provides:

- hyperlinks for linking DIANE documents
- media recorders for the integration of text, graphics, video, audio, application output, mouse pointer movements, markers on arbitrary positions in the document
- integration of HTML documents in a DIANE document

In addition to the annotation link semantics mentioned in section 2, a hyperlink with a similar behaviour to that of a HTML link is provided: if the link icon is pressed during a certain (visibility) period, the presentation is interrupted and the new target document starts playing; otherwise the presentation is continued. This feature allows it to combine documents in a common context without displaying them simultaneously (e.g. examples, references).

The integration of HTML documents makes it possible for the multimedia author to use the elaborate text formatting techniques of Hypertext or to include already existing WWW documents without changes.

Additionally to these generic functions, the instructor can also grab any portion of the computer screen displaying for example the output of an application or third-party tool and integrate it into a document. This feature is of particular interest, when instructors, as experts for a subject, intend to teach the use of special applications not available to the learners. Therefore, application output recording removes most restrictions on the subject of a teaching course, provided that the material is available in digital form (data or computer application).

On the other hand, the general document model used in DIANE can pose some problems to authors of educational material. An annotation document has always a time dimension extending static documents (text, HTML). This feature requires the authors of multimedia documents to think spatial and temporal dimensions (an displayed object, i.e. a window can not only be placed somewhere in the document, but appears at a specific time during the replay).

Nevertheless, the annotation feature reduces the gap between traditional and multimedia document composition by letting both tutors and students insert intuitively media during the replay of annotated document solely through the use of VCR well-known controls. Instructors do not have to build up a perfect teaching course from the beginning, they can do it gradually (e.g. it would be sufficient to create a minimal multimedia course containing no more than essential keywords like in transparencies with a soundtrack containing explanations of the teacher). This flexibility reduces the production time of multimedia documents considerably without reducing the quality of the course.

The second step in the teleteaching scenario with DIANE is the information exchange between teacher and learners based on the course material created in the first phase, and as mentioned above, this step is also an update and online-refinement of the course according to the special needs of the learners. DIANE offers the same capabilities for multimedia authoring to all users regardless of their roles. The same recorders necessary for integrating multimedia objects in the document, can also be used for annotations. The annotation feature of DIANE favours the asynchronous usage and is therefore appropriate for on-demand learning, learner support,

courses and lectures without loosing the collaborative element. In addition, synchronous sessions which make use of videoconferencing and application sharing applications can also be annotated for later processing.
The annotations of one learner can be made visible to the instructor, but also to other learners. Therefore, the information flow occurs not only between teacher and learners, but also between learners themselves, which is as important as the first one.

5. Conclusion

The DIANE user combines the roles of provider and consumer of multimedia information (or teacher and learner in a teleteaching scenario). Therefore, both sides can play an active role in the learning process, which is closer to traditional classroom teaching with its synergetic potential.
Through annotations, we have not only a way of producing educational content, but also building teaching scenarios and incorporating the collaborative component of conventional classroom education .
DIANE is being currently tested at VCPC with respect to the preparation of courseware for parallel programming tools and methods and to its ability to use this courseware in collaborative teaching sessions with students. Collaborative work scenarios are tested between two researchers teams in Vienna and Graz using broadband ATM network.

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